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Title: Fuel Cell Power Systems and Methods of Controlling a Fuel Cell Power System

PRELIMINARY AMENDMENT

To: Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

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Sir:

This Preliminary Amendment accompanies a request for Continuation Application. Prior to examining the application, please make the following amendments.

AMENDMENTS

In the Specification

At page 1, replace the paragraph after "RELATED PATENT DATA" with the following:

--This is a continuation of U. S. Patent Application Serial No. 09/322,666, filed on May 28, 1999, which in turn is a continuation-in-part of U. S. Patent Application Serial No. 09/108,667, filed on July 1, 1998, now U.S. Patent No. 6,096,449, which was a continuation-in-part of U.S. Patent Application Serial No. 08/979,853, filed on November 20, 1997, which is now U.S. Patent No. 6,030,718.--

In the Claims

Cancel claims 1-31.

32. (Amended) A fuel cell power system comprising:

a housing;

a plurality of terminals;

at least one fuel cell within the housing and electrically coupled with the terminals and configured to convert chemical energy into electricity;

a bleed valve configured to selectively purge non-fuel diluents from the at least one fuel cell; and

a control system configured to control selective positioning of the bleed valve.

33. The fuel cell power system according to claim 32 wherein the control system comprises a plurality of distributed controllers.

34. The fuel cell power system according to claim 32 wherein the at least one fuel cell comprises a plurality of polymer electrolyte membrane fuel cells.

35. The fuel cell power system according to claim 32 wherein the at least one fuel cell comprises a plurality of fuel cells.

36. The fuel cell power system according to claim 35 wherein the fuel cells are configured to be individually selectively deactivated and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the fuel cells deactivated.

37. The fuel cell power system according to claim 32 wherein the control system is configured to periodically open the bleed valve.

38. The fuel cell power system according to claim 32 further comprising a connection arranged to provide drainage from an anode side of the at least one fuel cell to the bleed valve.

Cancel claims 39-50.

51. (Amended) A fuel cell power system comprising:

a housing;

a plurality of terminals;

at least one fuel cell within the housing and electrically coupled with the terminals and configured to convert chemical energy into electricity;

a control system configured to monitor an electrical output condition of the at least one fuel cell and to control an operational parameter of at least one of the fuel cells; and

an operator interface coupled with the control system to indicate the electrical condition monitored by the control system.

52. The fuel cell power system according to claim 51 wherein the control system comprises a plurality of distributed controllers.

53. The fuel cell power system according to claim 51 wherein the at least one fuel cell comprises a plurality of polymer electrolyte membrane fuel cells.

54. The fuel cell power system according to claim 51 wherein the at least one fuel cell comprises a plurality of fuel cells.

55. The fuel cell power system according to claim 54 wherein the fuel cells are configured to be individually selectively deactivated and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the fuel cells deactivated.

56. The fuel cell power system according to claim 51 wherein the operator interface is positioned for observation from the exterior of the housing.

57. The fuel cell power system according to claim 51 wherein the operator interface comprises a display configured to emit a human perceptible signal.

58. The fuel cell power system according to claim 51 wherein the operator interface comprises interface switches configured to receive operator inputs.

59. (Amended) A fuel cell power system comprising:

a plurality of terminals;

a plurality of fuel cells respectively electrically coupled with the terminals and configured to convert chemical energy into electricity, the fuel cells being configured to be individually selectively deactivated and remaining ones of the fuel cells being configured to provide electricity to the terminals with others of the fuel cells deactivated;

a power supply, different from the fuel cells; and

a control system coupled to the power supply and configured to receive electricity from the power supply at least at some times, the control system being configured to monitor at least one operational condition of the power supply.

60. The fuel cell power system according to claim 59 wherein the control system comprises a plurality of distributed controllers.

61. The fuel cell power system according to claim 59 wherein the at least one fuel cell comprises a plurality of polymer electrolyte membrane fuel cells.

Cancel claims 62-64.

65. The fuel cell power system according to claim 59 wherein the power supply includes a battery.

66. The fuel cell power system according to claim 65 further comprising charge circuitry configured to selectively charge the battery responsive to control from the control system.

67. The fuel cell power system according to claim 59 further comprising an operator interface and the control system is configured to control the operator interface to indicate the at least one operational condition.

Cancel claims 68-74.

75. A fuel cell power system comprising:

a plurality of terminals;

a plurality of fuel cells electrically coupled with the terminals and configured to convert chemical energy into electricity;

a main valve adapted to couple with a fuel source and configured to selectively supply fuel to the fuel cells; and

a control system configured to control the main valve.

76. The fuel cell power system according to claim 75 wherein the control system comprises a plurality of distributed controllers.

77. The fuel cell power system according to claim 75 wherein the fuel cells comprise polymer electrolyte membrane fuel cells.

78. The fuel cell power system according to claim 75 wherein the fuel cells are configured to be individually selectively deactivated and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the fuel cells deactivated.

79. The fuel cell power system according to claim 75 further comprising a plurality of auxiliary valves configured to selectively supply fuel to respective fuel cells.

Cancel claims 80-262.

263. (New) The system according to claim 32 wherein the at least one fuel cell comprises a plurality of fuel cells provided in a plurality of cartridges, the system further comprising a manifold configured to provide fluid communication of the cartridges with the bleed valve.

264. (New) The system according to claim 32 further comprising a bleed timer and wherein the control system is configured to access the bleed timer to control the operation of the valve.

265. (New) The system of claim 32 and further comprising an operator interface coupled to the control system, wherein the operator interface comprises a display configured to indicate the electrical condition.

266. (New) The system of claim 51 and comprising a plurality of fuel cells, wherein the fuel cells are defined by multiple cartridges removably supported by the housing and that are individually selectively removed from the housing and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the cartridges removed.

267. (New) A fuel cell power system comprising:

a housing;

a temperature sensor supported by the housing to sense temperature in the housing;

a fan supported by the housing to move air inside the housing;

a plurality of terminals;

at least one fuel cell within the housing and electrically coupled with the terminals and configured to convert chemical energy into electricity;

a control system coupled to the temperature sensor and configured to control the fan in response to the sensed temperature; and

an operator interface coupled with the control system to indicate the temperature sensed by the control system.

268. (New) The fuel cell power system according to claim 267 and further comprising circuitry, electrically coupled to the control system, configured to at least at times determine the output voltage of the at least one fuel cell, wherein the fan is a variable speed fan, and wherein the control system varies the speed of the fan in response to the determined output voltage.

269. (New) The fuel cell power system according to claim 267 and further comprising circuitry, electrically coupled to the control system, configured to at least at times determine the output voltage of the at least one fuel cell, wherein the control system is configured to determine electrical efficiency based on the output voltage, wherein the fan is a variable speed fan, and wherein the control system varies the speed of the fan in response to the determined electrical efficiency.

270. (New) The fuel cell power system according to claim 269 and comprising a plurality of fuel cells, wherein voltage output determining circuitry is provided for each fuel cell, and wherein the control system is configured to determine the efficiency of each fuel cell by dividing the output voltage of that fuel cell by a theoretical maximum voltage of a single fuel cell.

271. (New) The fuel cell power system according to claim 270 wherein the control system is configured to determine an average efficiency for the fuel cells, and to control the speed of the fan based on the average efficiency.

272. (New) The fuel cell power system according to claim 267 and further comprising a temperature sensor supported by the housing to detect temperature outside the housing, and electrically coupled to the control system.

273. (New) The fuel cell power system according to claim 272 and further comprising an air passage, supported by the housing between the inside of the housing and the ambient, including a vane controllably movable between an open position and a closed position, and wherein the position of the vane is controlled by the control system at least partially in response to the temperature outside the housing.

274. (New) The fuel cell power system according to claim 267 wherein the control system comprises a plurality of distributed controllers.

275. (New) The fuel cell power system according to claim 267 wherein the at least one fuel cell comprises a plurality of polymer electrolyte membrane fuel cells.

276. (New) The fuel cell power system according to claim 267 wherein the at least one fuel cell comprises a plurality of fuel cells.

277. (New) The fuel cell power system according to claim 267 and comprising a plurality of fuel cells, wherein the fuel cells are configured to be individually selectively deactivated and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the fuel cells deactivated.

278. (New) The fuel cell power system according to claim 267 and comprising a plurality of fuel cells, wherein the fuel cells are defined by multiple cartridges removably supported by the housing and that are individually selectively removed from the housing and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the cartridges removed.

279. (New) The fuel cell power system according to claim 267 wherein the operator interface is positioned for observation from the exterior of the housing.

280. (New) The fuel cell power system according to claim 267 wherein the operator interface comprises a display configured to emit a human perceptible signal.

281. (New) The fuel cell power system according to claim 267 wherein the operator interface comprises interface switches configured to receive operator inputs.

282. (New) A fuel cell power system comprising:

a housing;

a plurality of terminals;

at least one fuel cell within the housing and electrically coupled with the terminals and configured to convert chemical energy into electricity;

a bleed valve in fluid communication with the at least one fuel cell to selectively remove waste fluid therefrom;

a control system configured to monitor an electrical output condition of at least one of the fuel cells and to control the bleed valve; and

an operator interface coupled with the control system to indicate the electrical condition monitored by the control system.

283. (New) The fuel cell power system according to claim 282 and further comprising a main valve in fluid communication with the at least one fuel cell and configured to be coupled between a fuel source and the at least one fuel cell, to control the supply of fuel to the at least one fuel cell, and wherein the control system is further configured to control the main valve.

284. (New) The fuel cell power system according to claim 282 and further comprising a fuel gas sensor supported by the housing to detect the concentration of fuel gas inside the housing, and wherein the control system is electrically coupled to the fuel gas sensor.

285. (New) The fuel cell power system according to claim 282 wherein the control system comprises a plurality of distributed controllers.

286. (New) The fuel cell power system according to claim 282 wherein the at least one fuel cell comprises a polymer electrolyte membrane.

287. (New) The fuel cell power system according to claim 282 and comprising a plurality of fuel cells, wherein the fuel cells are configured to be individually selectively deactivated and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the fuel cells deactivated.

288. (New) The fuel cell power system according to claim 282 and comprising a plurality of fuel cells, wherein the fuel cells are defined by multiple cartridges removably supported by the housing and that are individually selectively removed from the housing and remaining ones of the fuel cells are configured to provide electricity to the terminals with others of the cartridges removed.

289. (New) The fuel cell power system according to claim 282 wherein the operator interface is positioned for observation from the exterior of the housing.

290. (New) A fuel cell power system comprising:

a housing having an inside and an outside, and having a plurality of receptacles accessible from outside the housing, the receptacles respectively including an electrical connector and a fuel supply connector;

a plurality of cartridges each including a casing supporting at least one fuel cell, the casing being removably received in a receptacle and including a fuel inlet connector which mates with the fuel supply connector of at least one of the receptacles when the casing is received in a receptacle, and an electrical connector which mates with the electrical connector of at least one of the receptacles when the casing is received in a receptacle, each fuel cell being configured to convert chemical energy into electricity;

a power bus inside the housing and electrically coupled to the respective electrical connectors and selectively coupled to a load; and

a control system electrically coupled to the power bus and configured to monitor at least one operational condition of the power bus, wherein the cartridges are hot swappable.

291. (New) A fuel cell power system in accordance with claim 290 wherein a plurality of fuel cells are supported by each casing.

292. (New) A fuel cell power system in accordance with claim 290 wherein a casing is removable from the housing while the fuel cells of the remaining casings continue to supply power to the power bus.

293. (New) A fuel cell power system in accordance with claim 290 wherein each receptacle further includes a waste connector, and wherein each casing further includes a waste connector which mates with the waste connector of the receptacle when the casing is received in a receptacle.

294. (New) A fuel cell power system in accordance with claim 290 wherein the locations and configurations of connectors are selected such that a casing is selectively receivable in any of a number of the receptacles.

295. (New) The fuel cell power system according to claim 59 wherein the control system is a digital control system.

296. (New) The fuel cell power system according to claim 59 and further comprising a housing, and wherein the fuel cells are defined by multiple cartridges removably supported by the housing.

297. (New) A fuel cell power system comprising:

a plurality of terminals;

at least one fuel cell electrically coupled with the terminals and configured to convert chemical energy into electricity;

a power supply, different from the fuel cells; and

a control system coupled to the power supply and configured to receive electricity from the power supply at least at some times, the control system being configured to monitor at least one operational condition of the power supply.

298. (New) A fuel cell power method comprising:

providing a housing;

providing a plurality of terminals;

providing at least one fuel cell within the housing and electrically coupling the fuel cell with the terminals;

converting chemical energy into electricity using the fuel cell;

controlling a bleed valve using a control system to selectively purge non-fuel diluents from the at least one fuel cell.

299. (New) The fuel cell power method according to claim 298 and further comprising defining the control system using a plurality of distributed controllers.

300. (New) The fuel cell power method according to claim 298 and further comprising defining the least one fuel cell using a plurality of polymer electrolyte membrane fuel cells.

301. (New) The fuel cell power method according to claim 298 and further comprising defining the least one fuel cell using a polymer electrolyte membrane.

302. (New) The fuel cell power method according to claim 298 wherein providing at least one fuel cell comprises providing a plurality of fuel cells, the method further comprising selectively deactivating one of the fuel cells and providing electricity to the terminals from the remaining fuel cells.

303. (New) The fuel cell power method according to claim 298 wherein the selective purging comprises periodically opening the bleed valve using the control system.

304. (New) The fuel cell power method according to claim 298 wherein each fuel cell has an anode side and a cathode side and wherein the selective purging comprises draining non-fuel diluents from the anode side of the at least one fuel cell.

305. (New) The method according to claim 298 further comprising defining the at least one fuel cell using a plurality of fuel cells provided in a plurality of cartridges; and providing fluid communication between the cartridges and the bleed valve using a manifold.

306. (New) The method according to claim 298 and further comprising controlling the operation of the bleed valve using a bleed timer coupled to the control system.

307. (New) The method of claim 298 and further comprising providing an operator interface having a display; coupling the operator interface to the control system; sensing an electrical condition of the at least one fuel cell using the control system; and configuring the operator interface to indicate the electrical condition.

308. (New) A fuel cell power method comprising:

providing a housing;

providing a plurality of terminals;

providing at least one fuel cell within the housing and electrically coupling the at least one fuel cell with the terminals;

providing a control system;

coupling the operator interface to the control system;

controlling an operational parameter of at least one of the fuel cells using the control system;

converting chemical energy into electricity using the at least one fuel cell;

monitoring an electrical output condition of the at least one fuel cell using the control system; and

indicating the electrical output condition monitored by the control system using the operator interface.

309. (New) The fuel cell power method according to claim 308 and further comprising defining the control system using a plurality of distributed controllers.

310. (New) The fuel cell power method according to claim 308 and further comprising defining the at least one fuel cell using a plurality of polymer electrolyte membrane fuel cells.

311. (New) The fuel cell power method according to claim 308 and further comprising defining the at least one fuel cell using a plurality of fuel cells.

312. (New) The fuel cell power method according to claim 311 and further comprising individually selectively deactivating at least one of the fuel cells; and providing electricity to the terminals with another of the active fuel cells.

313. (New) The fuel cell power method according to claim 308 and further comprising locating the operator interface for observation from the exterior of the housing.

314. (New) The fuel cell power method according to claim 308 and further comprising using the operator interface to emit a human perceptible signal.

315. (New) The fuel cell power method according to claim 308 and further comprising receiving operator inputs from the operator interface via interface switches.

316. (New) The method of claim 308 and further comprising defining the at least one fuel cell using a plurality of fuel cells, wherein the fuel cells are further defined by multiple cartridges removably supported by the housing, and method further comprising individually removing selected ones of the cartridges from the housing; and providing electricity to the terminals using the remainder of the cartridges.

317. (New) A fuel cell power method comprising:

providing a plurality of terminals;

providing a plurality of fuel cells and electrically coupling the fuel cells with the terminals;

providing a power supply different from the fuel cells;

providing a control system;

configuring the power supply to selectively supply electricity to the control system at least at some times;

monitoring at least one operational condition of the power supply using the control system;

converting chemical energy into electricity using the plurality of fuel cells;

individually selectively deactivating one of the fuel cells while another of the fuel cells continues to convert chemical energy into electricity; and

providing electricity to the terminals from the active fuel cells.

318. (New) The fuel cell power method according to claim 317 and further comprising defining the control system using a plurality of distributed controllers.

319. (New) The fuel cell power method according to claim 317 and further comprising defining the plurality of fuel cells using a plurality of polymer electrolyte membrane fuel cells.

320. (New) The fuel cell power method according to claim 317 and further comprising defining the power supply using a battery.

321. (New) The fuel cell power method according to claim 320 and further comprising selectively charging the battery, responsive to control from the control system, using charge circuitry coupled to the fuel cells.

322. (New) The fuel cell power method according to claim 317 and further comprising indicating the at least one operational condition using an operator interface coupled with the control system.

323. (New) The fuel cell power method according to claim 317 and further comprising defining the control system using digital electronics.

324. (New) The fuel cell power method according to claim 317 and further comprising defining the fuel cells with a plurality of cartridges removably supported by a housing.

325. (New) A fuel cell power method comprising:

providing a plurality of terminals;

providing a plurality of fuel cells;

providing a main valve configured to couple with a fuel source;

electrically coupling the plurality of fuel cells with the terminals;

controlling the main valve with a control system;

selectively supplying fuel to the fuel cells using the main valve; and

converting chemical energy into electricity using the plurality of fuel cells.

326. (New) The fuel cell power method according to claim 325 and further comprising defining the control system using a plurality of distributed controllers.

327. (New) The fuel cell power method according to claim 325 and further comprising defining the fuel cells using polymer electrolyte membrane fuel cells.

328. (New) The fuel cell power method according to claim 325 and further comprising selectively deactivating one of the fuel cells while ones of the fuel cells continue to convert chemical energy into electricity; and providing electricity to the terminals from the fuel cells that continue to convert chemical energy into electricity.

329. (New) The fuel cell power method according to claim 325 and further comprising providing fuel to selected ones of the fuel cells using auxiliary valves.

330. (New) A fuel cell power method comprising:

providing a housing;

providing at least one fuel cell within the housing;

providing a plurality of terminals;

providing a control system;

providing an operator interface and coupling the operator interface to the control system;

electrically coupling the at least one fuel cell with the terminals;

supporting a temperature sensor from the housing to sense temperature in the housing, and coupling the temperature sensor to the control system;

moving air inside the housing using a fan supported by the housing;

controlling the fan in response to the sensed temperature using the control system;

converting chemical energy into electricity using the at least one fuel cell; and

indicating the temperature sensed by the control system using the operator interface.

331. (New) The fuel cell power method according to claim 330 and further comprising determining the output voltage of the at least one fuel cell, at least at times, using circuitry electrically coupled to the control system; and varying the speed of the fan in response to the determined output voltage using the control system.

332. (New) The fuel cell power method according to claim 330 and further comprising at least at times determining the output voltage of the at least one fuel cell; determining the electrical efficiency of the at least one fuel cell based on the output voltage using circuitry electrically coupled to the control system; and varying the speed of the fan in response to the determined electrical efficiency, using the control system.

333. (New) The fuel cell power method according to claim 332 and further comprising defining the at least one fuel cell using a plurality of fuel cells; determining the output voltage of each fuel cell; and determining the efficiency of each fuel cell by dividing the output voltage of that fuel cell by a theoretical maximum voltage of a single fuel cell, using the control system.

334. (New) The fuel cell power method according to claim 333 and further comprising determining an average efficiency for the fuel cells using the control system; and controlling the speed of the fan based on the average efficiency using the control system.

335. (New) The fuel cell power method according to claim 330 and further comprising detecting temperature outside the housing using a sensor supported by the housing and electrically coupled to the control system.

336. (New) The fuel cell power method according to claim 335 and further comprising providing an air passage supported by the housing and located between the inside of the housing and the ambient; positioning a vane located within the air passage using the control system, the vane being moveable between an open position and a closed position; and controlling the position of the vane at least partially in response to the temperature outside the housing.

337. (New) The fuel cell power method according to claim 330 and further comprising defining the control system using a plurality of distributed controllers.

338. (New) The fuel cell power method according to claim 330 and further comprising defining the at least one fuel cell using a plurality of polymer electrolyte membrane fuel cells.

339. (New) The fuel cell power method according to claim 330 and further comprising defining the at least one fuel cell using a plurality of fuel cells.

340. (New) The fuel cell power method according to claim 330 and further comprising defining the at least one fuel cell using a plurality of fuel cells; individually selectively deactivating one of the fuel cells; and providing electricity to the terminals with the active fuel cells.

341. (New) The fuel cell power method according to claim 330 and further comprising defining the at least one fuel cell using a plurality of fuel cells; further defining the fuel cells using multiple cartridges removably supported by the housing; individually selectively removing at least one of the cartridges from the housing; and providing electricity to the terminals with selected other ones of the cartridges.

342. (New) The fuel cell power method according to claim 330 and further comprising positioning the operator interface for observation from the exterior of the housing.

343. (New) The fuel cell power method according to claim 330 and further comprising emitting a human perceptible signal using a display coupled to the operator interface.

344. (New) The fuel cell power system according to claim 330 and further comprising receiving operator inputs from the operator interface using interface switches.

345. (New) A fuel cell power method comprising:

providing a housing;

providing a plurality of terminals;

providing at least one fuel cell within the housing;

electrically coupling the at least one fuel cell with the terminals;

converting chemical energy into electricity using the at least one fuel cell;

selectively removing waste fluid from the at least one fuel cell using a bleed valve;

monitoring an electrical output condition of at least one of the fuel cells and controlling the bleed valve, using a control system; and

indicating the electrical condition using an operator interface coupled with the control system.

346. (New) The fuel cell power method according to claim 345 and further comprising providing a main valve in fluid communication with the at least one fuel cell; and using the main valve to control a supply of fuel to the at least one fuel cell using the control system.

347. (New) The fuel cell power method according to claim 345 and further comprising detecting the concentration of fuel gas inside the housing using a fuel gas sensor supported by the housing and electrically coupled to the control system.

348 (New) The fuel cell power method according to claim 345 and further comprising defining the control system using a plurality of distributed controllers.

349. (New) The fuel cell power method according to claim 345 and further comprising defining the at least one fuel cell as comprising a polymer electrolyte membrane.

350. (New) The fuel cell power method according to claim 345 and further comprising defining the at least one fuel cell using a plurality of fuel cells; individually selectively deactivating ones of the fuel cells and activating selected ones of the other fuel cells; and providing electricity to the terminals with active fuel cells.

351 (New) The fuel cell power method according to claim 345 and further comprising defining the at least one fuel cell using a plurality of cartridges removably supported by the housing; individually selectively removing ones of the cartridges from the housing; and providing electricity to the terminals with other ones of the cartridges.

352. (New) The fuel cell power method according to claim 345 and further comprising positioning the operator interface for observation from the exterior of the housing.

353. (New) A fuel cell power method comprising:

providing a housing having an inside and an outside, and having a plurality of receptacles accessible from outside the housing, the receptacles respectively including an electrical connector and a fuel supply connector;

providing a plurality of hot swappable cartridges each including a casing supporting at least one fuel cell, the casing being removably received in a receptacle and including a fuel inlet connector which mates with the fuel supply connector of at least one of the receptacles when the casing is received in a receptacle, and an electrical connector which mates with the electrical connector of at least one of the receptacles when the casing is received in a receptacle;

selectively coupling respective electrical connectors of a power bus inside the housing to a load;

converting chemical energy into electricity using selected ones of the fuel cells; and

monitoring at least one operational condition of the power bus using a control system electrically coupled to the power bus.

354. (New) A fuel cell power method in accordance with claim 353 and further comprising providing a plurality of fuel cells in each casing..

355. (New) A fuel cell power method in accordance with claim 353 and further comprising selectively removing a casing from the housing while the fuel cells of the remaining casings continue to supply power to the power bus.

356. (New) A fuel cell power method in accordance with claim 353 and further

comprising providing respective waste connectors for each receptacle and casing, the method further comprising locating the waste connector of each casing to mate with the waste connector of the receptacle when the casing is received in the receptacle.

357. (New) A fuel cell power method in accordance with claim 353 and further comprising configuring the locations and configuration of respective connectors such that a casing is selectively receivable in any one of a number of the receptacles.

358. (New) A fuel cell power method comprising:

providing a plurality of terminals;

electrically coupling at least one fuel cell with the terminals;

providing a power supply, different from the fuel cells and coupling the power supply to a control system, to provide electricity to the control system;

converting chemical energy into electricity using the at least one fuel cell; and

monitoring at least one operational condition of the power supply using the control system.

REMARKS

This Preliminary Amendment accompanies a Request for Continuation application.

In the first Office Action (paper 4) of the parent application, claim 32 was rejected over U.S. Patent No. 6,013,385 to DuBose.

Claim 32, as amended, recites a fuel cell power system comprising, in part, at least one fuel cell, a bleed valve configured to selectively purge non-fuel diluents from the at least one fuel cell and a control system configured to control selective positioning of the bleed valve. Claim 32, as amended, recites patentable subject matter over the prior art of record.

In paragraph 7 of the Office Action it is alleged that DuBose discloses a fuel cell including a purge vent 96 which is periodically opened to atmosphere to purge hydrogen from the anode flow path with reference to column 8, lines 11-20 of DuBose. With reference to Fig. 3 in column 8, lines 11-20 it is stated that it is necessary to periodically vent a portion of the hydrogen from the anode loop through purge vent 96 to atmosphere. Referring to Fig. 3, purge vent 96 is depicted coupled with anode reservoir 92. Accordingly, DuBose teaches venting hydrogen from reservoir 92 and fails to teach or suggest a bleed valve configured to selectively purge non-fuel diluents from the at least one fuel cell, as required by claim 32. Claim 32 is allowable for at least this reason.

Further, claim 32 recites that the bleed valve is configured to purge non-fuel matter from the at least one fuel cell. As described in column 4 of the DuBose patent at line 15, it is clearly stated that vent 96 is utilized to vent a portion of the hydrogen fuel. Accordingly, DuBose fails to teach or suggest the defined bleed valve configured to purge non-fuel matter from the at least one fuel cell as specifically claimed.

Therefore, claim 32 is allowable.

Claims 33-38 and 263-265 which depend from independent claim 32 are in condition for allowance for the reasons discussed above with respect to the independent claim as well as for their own respective features which are neither shown nor suggested by the cited art.

In the parent application, claim 51 was rejected, in the first Office Action (paper 4), under 35 U.S.C. §102(e) for anticipation by U.S. Patent No. 6,001,499 to Grot et al.

Claim 51, as amended, recites a fuel cell power system comprising, in part, a control system configured to monitor an electrical output condition of at least one of the fuel cells and to control an operational parameter of at least one of the fuel cells, and an operator interface coupled with the control system to indicate the electrical condition monitored by the control system.

The Grot et al. reference is directed towards the problem of monitoring undesirably high concentrations of carbon monoxide gas from a fuel source (reformer), located upstream of a fuel cell, to avoid poisoning the catalyst of a fuel cell's anode. The Grot et al. reference indicates that "it is necessary to further remove carbon monoxide from the hydrogen-rich reformate stream exiting the shift reactor, and prior to supplying it to the fuel cell." See Col. 1, lines 53-58; and Col. 2, lines 23-24. The invention of Grot et al. relates to "a sensitive CO sensor utilizing a mini PEM fuel cell as a probe, and a method for real time monitoring of the CO concentration in the reformate feed stream to a PEM fuel cell as a means to control the operation of the fuel cell system. Thus, the invention of Grot et al. relates to a sensor that is used upstream of a fuel cell, for monitoring the fuel supplied to the fuel cell.

Thus, the Grot et al. reference fails to teach or suggest a control system configured to monitor an electrical output condition of at least one of the fuel cells, in combination with the other features of claim 51.

Therefore, claim 51 is allowable.

Further, the Grot et al. reference fails to teach or suggest an operator interface as claimed in applicants' claim 15. In the first Office Action (paper 4) for the parent application, it is alleged in paragraph 2 that the Grot et al. reference discloses a stack of polymer electrolyte fuel cells which are monitored and controlled in response to the level of CO in the fuel, which is related to their voltage output. The controlling is performed by a data processor which would be digital into which data may be inputted referring to teachings in column 10, lines 12-18. The Examiner alleges that the controller includes an operator interface. Applicants disagree.

Column 10, lines 12-18 of the Grot et al. reference refers to current and voltage of a PEM probe which are sampled and plotted over an interval of time which depict the behavior patterns for the voltage and current outputs. The behavior patterns are inputted as data streams into a data processor where they are compared to predetermined reference current and/or voltages. Referring to column 10, lines 35-40, once a match is made between a reference telltale output and a behavior pattern, CO concentration is determined from which adjustments can be made as needed. Accordingly, the teachings of Grot clearly refer to monitoring voltage and current of a sensor to determine CO concentrations within a hydrogen feed stream. The controller is configured to compare behavior patterns with known values and to make adjustments responsive thereto. Such in no fair interpretation discloses or suggests an operator interface as claimed in applicants' claim 51. Applicants have been unable to uncover any teachings or suggestion

of an operator interface as defined in claim 51 in the Grot teachings. The positively recited limitations of claim 51 are not shown or suggested in the prior art of record.

Accordingly, claim 51 recites patentable subject matter over the prior art of record.

Claims 52-58 and 266 which depend from independent claim 51 are in condition for allowance for the reasons discussed above with respect to the independent claim as well as for their own respective features which are neither shown nor suggested by the cited art.

New claims 267 and 282 are similar to original claim 51 but recite specific parameters being controlled. Claims 268-281 depend on claim 267 and claims 283-290 depend on claim 282. Examination on the merits is requested.

In the parent application, claim 59 was rejected, in the second Office Action (paper 9), under 35 U.S.C. §103(a) for anticipation by U.S. Patent No. 5,334,463 to Tajima et al.

Claim 59, as amended, recites in part fuel cells being configured to be individually selectively deactivated and remaining ones of the fuel cells being configured to provide electricity to the terminals with others of the fuel cells deactivated, and therefore distinguishes over the Tajima et al. reference.

Claims 60-61, 65-67, and 295-296 which depend from independent claim 59 are in condition for allowance for the reasons discussed above with respect to the independent claim as well as for their own respective features which are neither shown nor suggested by the cited art.

New claims 290-294 have been added and are believed to be allowable for reasons that made claims in the parent application allowable. Examination on the merits is requested.

New claim 297 is similar to original claim 59, but recites, in part, a control system

coupled to the power supply and configured to receive electricity from the power supply at least at some times, the control system being configured to monitor at least one operational condition of the power supply.

The Tajima et al. reference fails to teach or suggest a control system coupled to a power supply different from the fuel cell and configured to receive electricity from the power supply at least at some times, the control system being configured to monitor at least one operational condition of the power supply.

Claim 75 was rejected, in the first Office Action (paper 4), under 35 U.S.C. §102(e) for anticipation by U.S. Patent No. 6,001,499 to Grot et al. Reconsideration is respectfully requested. The Grot et al. reference relates to monitoring current through and voltage across a load connected to a probe at a hydrogen fuel feed manifold to a fuel cell stack, and does not in any way teach or suggest a main valve adapted to couple with a fuel source and configured to selectively supply fuel to the fuel cells; and a control system configured to control the main valve. At best, Grot et al. suggests controlling an air injection rate to a PROX reactor (in Col 10, lines 49-59), but this is not the same as controlling a main valve to a fuel cell.

Accordingly, claim 75 recites patentable subject matter over the prior art of record.

Claims 76-79 which depend from independent claim 75 are in condition for allowance for the reasons discussed above with respect to the independent claim as well as for their own respective features which are neither shown nor suggested by the cited art.

New claims 298 -358 are method claims that generally parallel the apparatus claims described above and are allowable for reasons similar to those described above.

The Examiner is requested to phone the undersigned if the Examiner believes such

would facilitate prosecution of the present application. The undersigned is available for telephone consultation at any time during normal business hours (Pacific Time Zone).

Respectfully submitted,

Dated: November 21, 2001 By: [signature]

Deepak Malhotra
Reg. No. 33,560

Application Serial No. ..... Filed Herewith
Filing Date ..... Filed Herewith
Inventor ..... William Fuglevand et al.
Assignee ..... Avista Laboratories, Inc.
Group Art Unit ..... Unknown
Examiner ..... Unknown
Attorney's Docket No. AV1-059
Title: "Fuel Cell Power Systems"

VERSION WITH MARKINGS TO SHOW CHANGES MADE ACCOMPANYING PRELIMINARY AMENDMENT

In the Specification

The paragraph at page 1, after "RELATED PATENT DATA" is being amended as follows (underlines indicate additions, ~~strikeouts~~ indicate deletions):

This is a continuation of U. S. Patent Application Serial No. 09/322,666, filed on May 28, 1999, which in turn ~~The present application~~ is a continuation-in-part of U. S. Patent Application Serial No. 09/108,667, filed on July 1, 1998, now U.S. Patent No. 6,096,449, which was a continuation-in-part of U.S. Patent Application Serial No. 08/979,853, filed on November 20, 1997, which is now U.S. Patent No. 6,030,718.

In the Claims

The claims have been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

Claims 1-31 have been canceled.

32. (Amended) A fuel cell power system comprising:

a housing;

a plurality of terminals;

at least one fuel cell within the housing and electrically coupled with the terminals and configured to convert chemical energy into electricity;

a bleed valve configured to selectively purge non-fuel diluents ~~matter~~ from the at least one fuel cell; and

a control system configured to control selective positioning of the bleed valve.

Claims 39-50 have been canceled.

51. (Amended) A fuel cell power system comprising:

a housing;

a plurality of terminals;

at least one fuel cell within the housing and electrically coupled with the terminals and configured to convert chemical energy into electricity;

a control system configured to ~~at least one of control and~~ monitor an electrical output condition ~~an operation~~ of the at least one fuel cell and to control an operational parameter of at least one of the fuel cells; and

an operator interface coupled with the control system to indicate the electrical condition monitored by the control system ~~at least one operational status responsive to control from the control system~~.

59. (Amended) A fuel cell power system comprising:

a plurality of terminals;

a plurality of ~~at least one~~ fuel cells respectively ~~cell~~ electrically coupled with the terminals and configured to convert chemical energy into electricity, the fuel cells being configured to be individually selectively deactivated and remaining ones of the fuel cells being configured to provide electricity to the terminals with others of the fuel cells deactivated;

a power supply, different from the fuel cells ~~configured to selectively supply electricity~~; and

a control system coupled to the power supply and configured to receive electricity from the power supply at least at some times, the control system being configured to monitor at least one operational condition of the power supply.

Claims 62-64 have been canceled.

Claims 68-74 have been canceled.

Claims 80-262 have been canceled.

New claims 263-358 have been added.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Priority Application Serial No. 09/322,666
Priority Filing Date . . . . . May 28, 1999
Inventor . . . . . William Fuglevand et al.
Assignee . . . . . Avista Laboratories, Inc.
Priority Group Art Unit 1745
Priority Examiner . . . . . S. Kalafut
Attorney's Docket No. AV1-059
Title: Fuel Cell Power Systems and Methods of Controlling a Fuel Cell Power System

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Assistant Commissioner for Patents
Washington, D. C. 20231
Attention: Official Draftsman

SUBSTITUTE DRAWING REQUEST

Please enter the enclosed substitute drawings in the above-referenced application in place of drawings originally filed. The content of the drawings are identical to those now on file in this application.

Acknowledgment of receipt of the formal drawings and their acceptance into the file is requested.

Respectfully submitted,

Date: November 21, 2001

By: _____

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Enclosures: 28 Sheets of Formal Drawings, Figs. 1-28.